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Dodd

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(54) **IMPACT DISTRIBUTING MECHANISM**

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This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

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(51) **Int. Cl.**

A63B 71/12	(2006.01)
A41D 13/015	(2006.01)
A41D 13/05	(2006.01)

(52) **U.S. Cl.**

CPC ***A63B 71/1225*** (2013.01); ***A41D 13/0153*** (2013.01); ***A41D 13/0543*** (2013.01); *A63B 2071/1258* (2013.01); *Y10T 29/49826* (2015.01)

(58) **Field of Classification Search**

CPC A41D 13/08; A41D 13/065; A41D 13/05668; A63B 71/1225; A61F 5/026; A61F 5/028; A61F 5/0111; A61F 13/069; A61F 13/00; A61F 13/14; A61F 13/061

USPC 2/16, 22, 23, 24, 44, 45, 267, 455, 911; 128/882, 892; 602/23, 60, 61, 62

See application file for complete search history.

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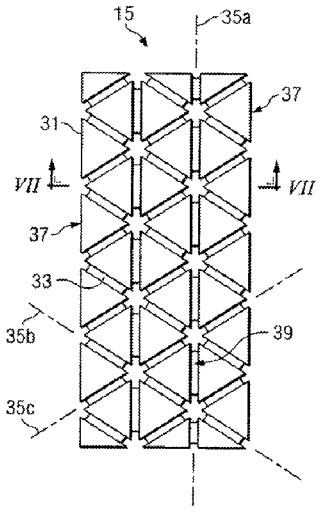
(57) **ABSTRACT**

An article is provided that includes a core including a plurality of triangular core members. Two or more edges of each triangular core member are each attached to respective edges of other triangular core members in the plurality of triangular core members by respective hinges in a plurality of hinges. Each hinge in the plurality of hinges joins respective edges of a respective pair of substantially adjacent triangular core members in the plurality of triangular core members, is of a length to provide an offset between the pair of triangular core members, has a thickness less than thicknesses of the pair of triangular core members, and is integrally connected to the pair of triangular core members.

21 Claims, 3 Drawing Sheets



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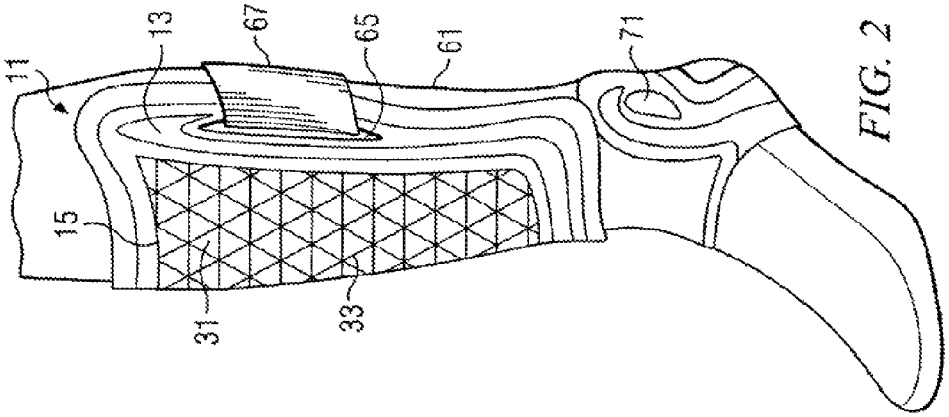

FIG. 2

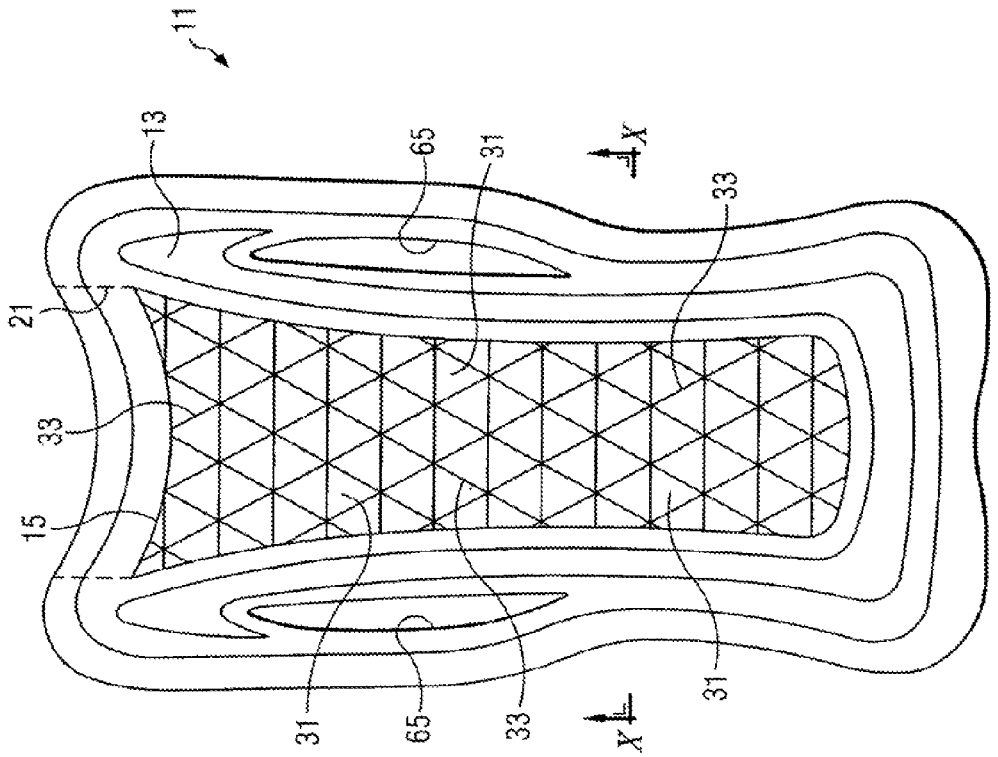

FIG. 1

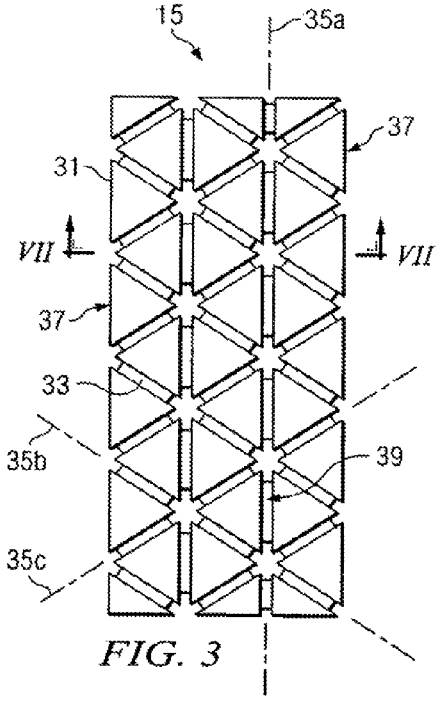

FIG. 3

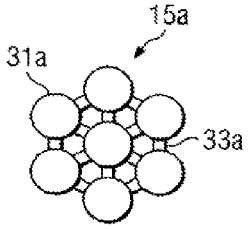

FIG. 4

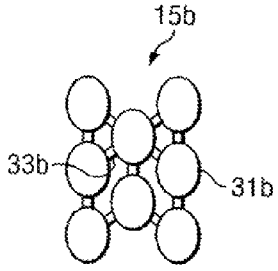

FIG. 5

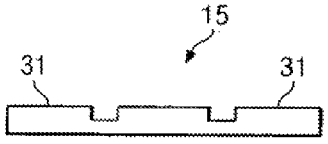

FIG. 7

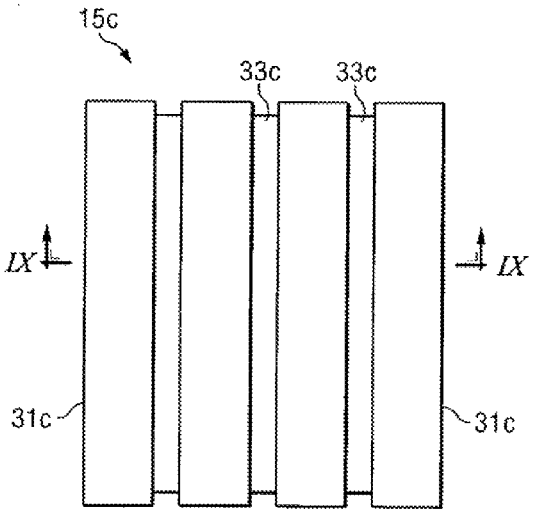

FIG. 6

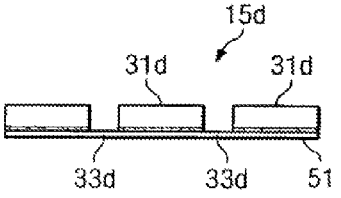

FIG. 8

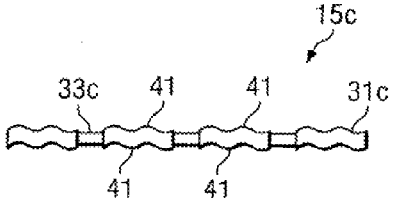

FIG. 9

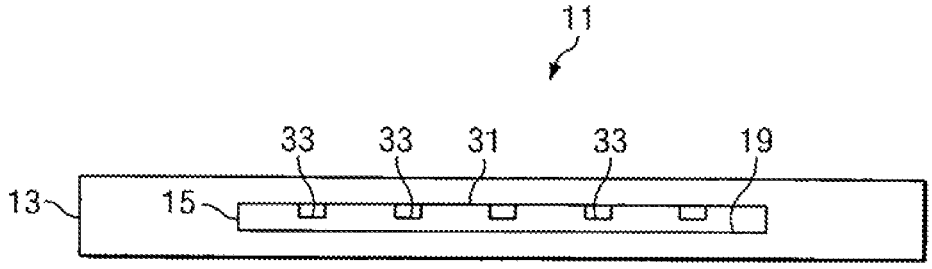

FIG. 10

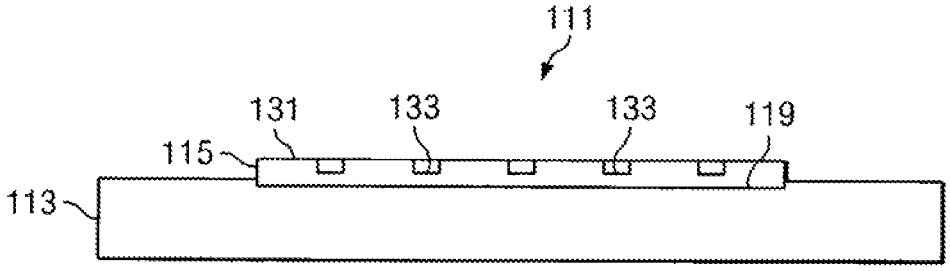

FIG. 11

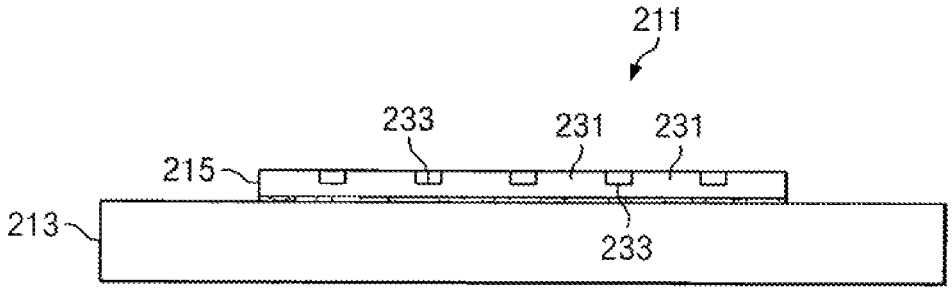

FIG. 12

IMPACT DISTRIBUTING MECHANISM

CROSS REFERENCE TO RELATED APPLICATIONS

This Application is a continuation (and claims the benefit of priority under 35 U.S.C. §120) of U.S. application Ser. No. 14/154,090 filed on Jan. 13, 2014, and entitled "PROTECTIVE SHIN GUARD", which application is a continuation of Ser. No. 13/545,381, filed on Jul. 10, 2012, now issued as U.S. Pat. No. 8,627,512, and entitled "IMPACT DISTRIBUTING MECHANISM", which application is a continuation of Ser. No. 11/057,954, filed Feb. 15, 2005, now issued as U.S. Pat. No. 8,220,072 and entitled "PROTECTIVE SHIN GUARD", each naming Mark D. Dodd as inventor. The disclosures of the prior Applications are considered part of and are incorporated by reference in its entirety in the disclosure of this Application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to protective equipment and in particular to protective guards for extremities such as shins to be worn while engaging in sports activities.

2. Description of Related Art

Shin guards are widely used in amateur and professional soccer to protect players' lower legs and shins from impact with other players. In soccer, since players advance the soccer ball through kicking, players are frequently kicked in the shin and lower leg by other players. Without adequate protection, the risk of injury is high.

Existing shin guards provide some protection for the shins of soccer players, but the guards are typically bulky and uncomfortable. The existing shin guards are typically a single piece of rigid plastic and are secured to the shin and lower leg using straps or special sleeves. While the existing shin guards are manufactured in different sizes, obtaining a "custom" fit is almost impossible, and the shin guards often protrude outward from each side of the player's leg. The lack of custom sizing available with existing shin guards makes them less comfortable to wear, and the guards could under some circumstances impede the movement of the player. Finally, a guard that does not fit properly also fails to provide maximum impact protection to the player.

A need exists, therefore, for a protective guard that provides a customized fit to a person's leg or other body part. A protective guard is further needed that is easily adjustable to extremities of different sizes and shapes so that a minimum number of sizes can be manufactured. Finally, a protective guard is needed that is easy to manufacture and is comfortable to wear during extended periods of exertion.

BRIEF SUMMARY OF THE INVENTION

The problems presented by existing protective guards are solved by the protective guard of the present invention. The protective guard includes an elastomeric sheath having a pocket disposed therein. The protective guard further includes a central core having a plurality of rigid plates. The central core is disposed within the pocket of the elastomeric sheath. The plurality of rigid plates includes a first plate that is joined by at least one hinge to a second plate.

Also in accordance with the principles of the present invention, a protective guard having a conformable substrate and a plurality of core members is provided. The plurality of core members are at least partially embedded within the conformable substrate. The core members are arranged such that a first of the core members is rotationally movable about at least one axis relative to a second of the core members.

Also in accordance with the principles of the present invention, a protective guard is provided that includes a conformable substrate and a plurality of core members disposed adjacent to a surface of the conformable substrate. The core members are arranged such that a first of the core members is rotationally movable about at least one axis relative to a second of the core members.

Also in accordance with the principles of the present invention, a protective guard is provided that includes an elastomeric substrate and a plurality of non-elastomeric core members. The non-elastomeric core members are at least partially embedded within the elastomeric substrate.

Other objects, features, and advantages of the present invention will become apparent with reference to the drawings and detailed description that follow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a front view of a protective guard according to the present invention, the protective guard having a conformable substrate and a central core disposed therein;

FIG. **2** depicts a perspective view of the protective guard of FIG. **1** secured to a leg of a person;

FIG. **3** illustrates a partial front view of the central core of FIG. **1**, the central core including a plurality of core members;

FIG. **4** depicts a partial front view of a plurality of round core members according to the principles of the present invention;

FIG. **5** illustrates a partial front view of a plurality of oval core members according to the principles of the present invention;

FIG. **6** depicts a partial front view of a plurality of rectangular core members according to the principles of the present invention;

FIG. **7** illustrates a cross-sectional bottom view of the core members of FIG. **3** taken at VII-VII;

FIG. **8** depicts a cross-sectional bottom view similar to FIG. **7** of a plurality of core members according to the principles of the present invention;

FIG. **9** illustrates a cross-sectional bottom view of the core members of FIG. **6** taken at IX-IX;

FIG. **10** depicts a cross-sectional bottom view of the conformable substrate and central core of FIG. **1** taken at X-X;

FIG. **11** illustrates a cross-sectional bottom view similar to FIG. **10** of a conformable substrate and central core according to the principles of the present invention; and

FIG. **12** depicts a cross-sectional bottom view similar to FIG. **10** of a conformable substrate and central core according to the principles of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific preferred embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is understood that other embodiments may be utilized and that logical structural, mechanical, chemical, and material changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to

practice the invention, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is defined only by the appended claims.

As used herein, the term "elastomer" refers to a polymeric or rubber (natural or synthetic) material that has elongation rates greater than 100%.

The term "conformable" refers to the ability of a material to be shaped to the contours of a surface without permanently deforming or setting the material. The conformable material could be placed adjacent to a first surface to provide a contour fit to the first surface, and then could subsequently be placed adjacent a second surface and similarly provide a contour fit to the second surface.

Referring to FIG. **1**, a protective guard **11** according to the principles of the present invention includes a conformable substrate **13** and a central core **15**. The central core **15** is connected to or embedded within the conformable substrate **13** to provide impact protection to a body part of a person. The conformable substrate **13** preferably includes a pocket **19** (see FIG. **10**) within the conformable substrate that houses the central core **15**. When the central core **15** is contained within pocket **19**, the conformable substrate **13** functions as a sheath, and an entry slot **21** may be optionally provided to allow access to pocket **19**, thereby allowing the central core **15** to be selectively removed or inserted into the conformable substrate **13**. However, it is preferable that the pocket **19** is not accessible by an entry slot, thereby creating a sealed space for the conformable substrate **13**. The pocket **19** closely matches the shape of the central core **15** and is preferably formed by molding the conformable substrate **13** around the central core **15**.

The conformable substrate **13** is preferably constructed from an elastomeric material such that the conformable substrate **13** can be easily wrapped around and shaped to the contours of a person's lower leg or shin **61** (see FIG. **2**). The preferred material for the conformable substrate is Monprene MP-1880, a thermoplastic elastomer manufactured by Teknor Apex, Thermoplastic Elastomer Division of Pawtucket, R.I. Other suitable materials could include without limitation other thermoplastic elastomers, natural rubber, polyisoprene, styrene butadiene rubber, chloroprene rubber, polybutadiene, nitrile rubber, butyl rubber, ethylene propylene rubber, ethylene propylene diene rubber, chlorosulfonated polyethylene, polysulfide rubber, silicone rubber, polyurethane, and closed or open-cell neoprene or foam.

Referring to FIG. **3**, the central core **15** includes a plurality of core members **31**. Each core member is preferably joined by at least one hinge **33** to another of the core members **31** such that the core members **31** are capable of rotational movement relative to one another. The rotational movement between two core members typically occurs along an axis that is positioned between the core members. When hinges **33** are used to connect the core members **31**, the axis of rotation corresponds to the rotational axis of the hinge. Representative axes of rotation for the central core **15** of FIG. **3** are illustrated as axis **35***a*, axis **35***b*, and axis **35***c*. The ability of the core members **31** to rotationally move relative to one another allows the central core **15** to be conformable to a shin of a person even though the material that forms the core members **31** would not necessarily be conformable if used in a single piece.

Referring more specifically to FIGS. **3-6**, the core members could be any shape or size. While the preferred shape is the triangular shape of core members **31** (FIG. **3**), a central core **15***a* is partially shown in FIG. **4** having round core members **31***a* connected by hinges **33***a*. FIG. **5** partially illustrates a central core **15***b* having a plurality of oval core members **31***b* connected by hinges **33***b*. FIG. **6** partially illustrates a central core **15***c* having rectangular core members **31***c* connected by hinges **33***c*. Other shapes could include without limitation hexagonal, octagonal, or free-form shapes.

Referring to FIG. **7**, the core members **31** of protective guard **11** are preferably substantially flat, rigid plates constructed from a non-elastomeric material. In a preferred embodiment, the core members **31** are made from a hard plastic material such as acrylonitrile butadiene styrene (ABS), styrene, polyethylene, polypropylene, acrylic, polyvinyl chloride (PVC), fluoroplastics, nylon, acetal, polycarbonate, polyimide, polyamide-imide, polyphenylene sulfide, polyarylates, polyethylene terephthalate, polybutylene terephthalate, polyether ether ketone, polysulfone, polyether sulfone, polyetherimide, or polyphenylene oxide. However, it should be understood that any rigid material may be used, including composites, metal, or wood. Although a non-elastomeric material is preferred, the core members **31** could even be formed from an elastomeric material if rotational movement between the core members **31** would allow the elastomeric material to better conform to the shin of a person. Preferably, the material used to form the core members **31**, and thus the central core **15**, is a material that is compatible with the material chosen for the conformable substrate **13**. Since it is preferred to mold the conformable substrate **13** over the central core **15**, it is highly desirous to use a central core material to which the conformable substrate **13** will adhere. A coating or adhesive may be applied to the central core **15** prior to the molding process to achieve additional adhesion between the central core **15** and the conformable substrate **13**.

Referring to FIG. **9**, the central core **15**c of FIG. **6** is illustrated in cross section and includes core members **31***c* connected by hinges **33***c*. While it is preferred that the core members of the present invention be substantially flat so that an impact force directed to the protective guard does not damage the conformable substrate, the core members **31***c* illustrated in FIG. **9** include ridges **41**. The ridges **41** may be capable of absorbing additional energy by flattening in the presence of an impact force. Other alternatives to a substantially flat core member may be provided by a core member that is slightly concave or convex in cross section. The core members could alternatively be fluid-filled capsules such as those containing air or gel, or the core members could also be a plastic or metal mesh that is hinged together similar to chain mail armor.

Referring again to FIG. **7** and also to FIG. **8**, the hinges that connect the core members could be provided in several different forms. FIG. **7** illustrates the preferred hinge **33**, which is a "living hinge." The living hinge is preferably integrally attached between the core members **31** and is made from the same material as each of the core members **31**. The living hinge may be created by machining or etching the core members **31** from a single sheet of material having a relatively constant thickness. The sheet of material is thinned in any region that will become a hinge. This thinning process to create the hinges **33** also creates the general shape of the core members **31**. Living hinges are a strong way of maintaining a rotational connection between core members **31**. The living hinges **33** allow repeated rotations between core members **31** while maintaining the relative positions of the core members **31** during the process of assembling the central core **15** and the conformable substrate **13**.

Referring to FIG. **8**, another option for providing hinges is illustrated in reference to a central core **15***d* having core

members **31***d* and hinges **33***d*. Hinges **33***d* are formed by arranging precut core members **31***d* onto a membrane or other material **51** that includes an adhesive to secure the core members **31***d* to the membrane **51**. The membrane **51** could be an adhesive tape or other film, or alternatively the membrane could be another piece of plastic or elastomer to which the core members **31***d* are bonded. Membrane **51** could be applied to both sides of the core members **31***d* or only on one side as shown in FIG. **8**.

Although not illustrated, mechanical, multi-part hinges could also be used to connect adjacent core members.

Referring again to FIG. **3**, certain of the core members are located in an outer perimeter region **37**, while other of the core members are located in an inner region **39**. The core members **31** located in the inner region **39** are preferably connected by hinges **33** along each edge of the core member **31** to each adjacent core member **31**. For core members **31** located in the outer perimeter region **37**, hinges **33** are only attached to one or two edges of each core member **31**. However, regardless of whether a particular core member **31** is disposed within the outer perimeter region **37** or the inner region **39**, it is not required that every edge of a core member **31** be connected by a hinge to another core member **31**. In fact, hinges are not mandatory. Hinges simply provide a good way to maintain relative positioning of the core members **31** during assembly of the central core **15** and the conformable substrate **13**. If the relative positioning of the core members **31** could be maintained without hinges, the fixation of the core members **31** within or to the conformable substrate **13** would allow the desired capability of rotational movement between adjacent core members **31**. Alternatives for positioning the core members **31** are discussed below in reference to the assembly of the central core **15** and the conformable substrate **13**.

Referring to FIG. **10**, the protective guard **11** preferably includes core members **31** that are completely embedded within the conformable substrate **13**. As mentioned previously, a pocket **19** could be provided with an entry slot that allows for insertion of the central core **15** after the conformable substrate **13** is formed. However, it is preferred that the central core **15** be molded within the conformable substrate **13**, which would automatically form a pocket **19** around the central core **15**. It is preferred that hinges **33** are present between the core members **31** to maintain the relative position of the core members **31** during the molding process. It is possible, however, that the core members **31** be individually placed during the molding process to eliminate the need for the hinges **33**. After the molding process, the relative positions (e.g. spacing) of the core members **31** would be fixed within the conformable substrate **13**, yet the core members **31** would still be capable of rotational movement relative to one another.

Referring to FIG. **11**, a protective guard **111** having a conformable substrate **113** and a central core **115** is illustrated. The central core **15** includes a plurality of core members **131** connected by hinges **133**. The central core **115** is partially embedded within a pocket **119** of the conformable substrate **113**, thereby exposing the core members **131** near a surface of the conformable substrate **113**. The central core **115** may be secured to the conformable substrate **113** by the embedding process, or a bonding agent or other adhesive may be used to further secure the central core **115**. As discussed previously in reference to FIG. **10**, the hinges **133** between core members **131** could be eliminated if the core members **131** were individually placed during the assembly process. Individual core members **131** could be placed during the molding of the conformable substrate **113**, or the core members could be bonded within the pocket **119** of the conformable substrate **113** after the molding process is complete. After securing the core members **131** to the conformable substrate **113**, the relative positions (e.g. spacing) of the core members **131** would be fixed, yet the core members **131** would still be capable of rotational movement relative to one another.

Referring to FIG. **12**, a protective guard **211** having a conformable substrate **213** and a central core **215** is illustrated. The central core **215** includes a plurality of core members **231** connected by hinges **233**. The central core **215** is bonded to a surface of the conformable substrate **213**. The central core **215** is preferably secured to the conformable substrate **213** by a bonding agent or adhesive. As discussed previously with reference to FIGS. **10** and **11**, the hinges **233** between core members **231** could be eliminated if the core members **231** were individually placed during the bonding process. After securing the core members **231** to the conformable substrate **213**, the relative positions (e.g. spacing) of the core members would be fixed, yet the core members would still be capable of rotational movement relative to one another.

In use, the protective guard **11**, **111**, **211** of the present invention provides impact protection for an extremity or other body part of a person. As shown in FIG. **2**, the protective guard **11** is conformable to the shin and lower leg **61** of a person. The conformable substrate **13** and the central core **15** combine to provide superior impact protection. While the conformable substrate **13** by itself is conformable to a leg or other body part, the more rigid characteristics of the material used in the central core **15** would normally not be easily conformable to the person's leg. However, by separating the central core **15** into a plurality of core members **31** and by allowing the core members **31** to be rotationally movable relative to one another, the central core **15** as a whole is also conformable to the leg of the person. An attachment aperture **65** is provided on each side of the conformable substrate **13** to allow protective guard **11** to be attached to the person's leg with a strap **67** routed through the attachment aperture **65**. An ankle guard **71** may also be provided to wrap around the ankle of the person. The ankle guard **71** could include a central core, but preferably is formed solely from the conformable substrate used with protective guard **11**, **111**, **211**. Similarly, the protective guard itself could be formed solely from the conformable substrate and used without the central core. If only the conformable substrate is used, the material may be thicker in areas of predicted impact or may be formed from two or more elastomers having different durometers (i.e. a multi-durometer conformable substrate).

It should be noted that the protective guard **11**, **111**, **211** of the present invention could be used to protect body parts other than the lower leg of a person including without limitation forearms, elbows, and knees. The protective guard **11**, **111**, **211** could also be used to protect body parts of non-human animals as well.

It should be apparent from the foregoing that an invention having significant advantages has been provided. While the invention is shown in only a few of its forms, it is not just limited but is susceptible to various changes and modifications without departing from the spirit thereof.

I claim:

1. An article comprising:

a core comprising a plurality of triangular core members, wherein two or more edges of each triangular core member are each attached to respective edges of other triangular core members in the plurality of triangular core members by respective hinges in a plurality of hinges,

wherein each hinge in the plurality of hinges joins respective edges of a respective pair of substantially adjacent triangular core members in the plurality of triangular core members, is of a length to provide an offset between the pair of triangular core members, has a thickness less than thicknesses of the pair of triangular core members, and is integrally connected to the pair of triangular core members.

2. The article of claim **1**, further comprising a substrate having impact protection properties disposed substantially adjacent to the core.

3. The article of claim **2**, wherein the substrate is an elastomeric substrate.

4. The article of claim **2**, wherein the core is secured to the substrate.

5. The article of claim **4**, wherein the core is at least partially embedded within the substrate.

6. The article of claim **5**, wherein the substrate is formed around the core to at least partially enclose the core within the substrate.

7. The article of claim **4**, wherein the core is bonded to the substrate.

8. The article of claim **2**, wherein each of the plurality of triangular core members comprises a rigid plate and the substrate is less rigid than the plurality of triangular core members.

9. The article of claim **1**, wherein the hingedly attached triangular core members form a plurality of openings in the core.

10. The article of claim **9**, wherein the plurality of openings are substantially uniform in size and shape.

11. The article of claim **1**, wherein the plurality of triangular core members and plurality of hinges are formed from a same material.

12. The article of claim **1**, wherein the offset comprises the length.

13. The article of claim **1**, wherein each of the plurality of hinges is of substantially the same length.

14. An article comprising:

a foam substrate; and

an interconnected plurality of rigid triangular members disposed substantially adjacent to the foam substrate, wherein each rigid triangular member in the plurality of rigid triangular members is joined to at least one other rigid triangular member in the plurality of rigid triangular members by a respective hinge, and each hinge:

joins the edges of two corresponding rigid triangular members in the plurality of rigid triangular members,

is integrally formed with the two corresponding rigid triangular members,

is thinner than the thickness of each of the two corresponding rigid triangular members, and

provides an offset between the edges of the two corresponding rigid triangular members joined by the hinge.

15. The article of claim **14**, wherein the plurality of rigid triangular members are more rigid than the foam substrate.

16. The article of claim **14**, wherein each hinge further allows multidirectional movement of the triangular members, joined by the hinge, relative the other.

17. The article of claim **14**, wherein the article is adapted to conform around and protect at least a portion of a human body.

18. The article of claim **17**, further comprising a wearable protection device comprising the foam substrate and the interconnected plurality of rigid triangular members.

19. The article of claim **14**, wherein the interconnected plurality of rigid triangular members provides impact resistant properties.

20. An article comprising:

a core comprising a plurality of core members, wherein each core member in the plurality of core members is substantially triangular in shape and has two or more edges attached to respective edges of other core members in the plurality of core members by respective hinges in a plurality of hinges,

wherein a first one of the plurality of hinges joins a first edge of a first one of the plurality of core members to a first edge of a second one of the plurality of core members, a second one of the plurality of hinges joins a second edge of the second core member to a first edge of a third one of the plurality of core members, a third one of the plurality of hinges joins a second edge of the third core member to a first edge of a fourth one of the plurality of core members, a fourth one of the plurality of hinges joins a second edge of the fourth core member to a first edge of a fifth one of the plurality of core members, a fifth one of the plurality of hinges joins a second edge of the fifth core member to a first edge of a sixth one of the plurality of core members, and a sixth one of the plurality of hinges joins a second edge of the sixth core member to a second edge of the first to form a ring of core members, the ring of core members forms one of a plurality of openings in the core, the plurality of core members further comprises a seventh core member attached to a third edge of the first core member by a seventh one of the plurality of hinges, and each hinge in the plurality of hinges has a thickness less than a largest thickness of each core member joined by the hinge.

21. A method for reinforcing a substrate, the method comprising:

securing a rigid core to the substrate, wherein the rigid core comprises a plurality of triangular core members, wherein two or more edges of each triangular core member are each attached to respective edges of other triangular core members in the plurality of triangular core members by respective hinges in a plurality of hinges,

wherein each hinge in the plurality of hinges joins respective edges of a respective pair of substantially adjacent triangular core members in the plurality of triangular core members, is of a length to provide an offset between the pair of triangular core members, has a thickness less than thicknesses of the pair of triangular core members, and is integrally connected to the pair of triangular core members.

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